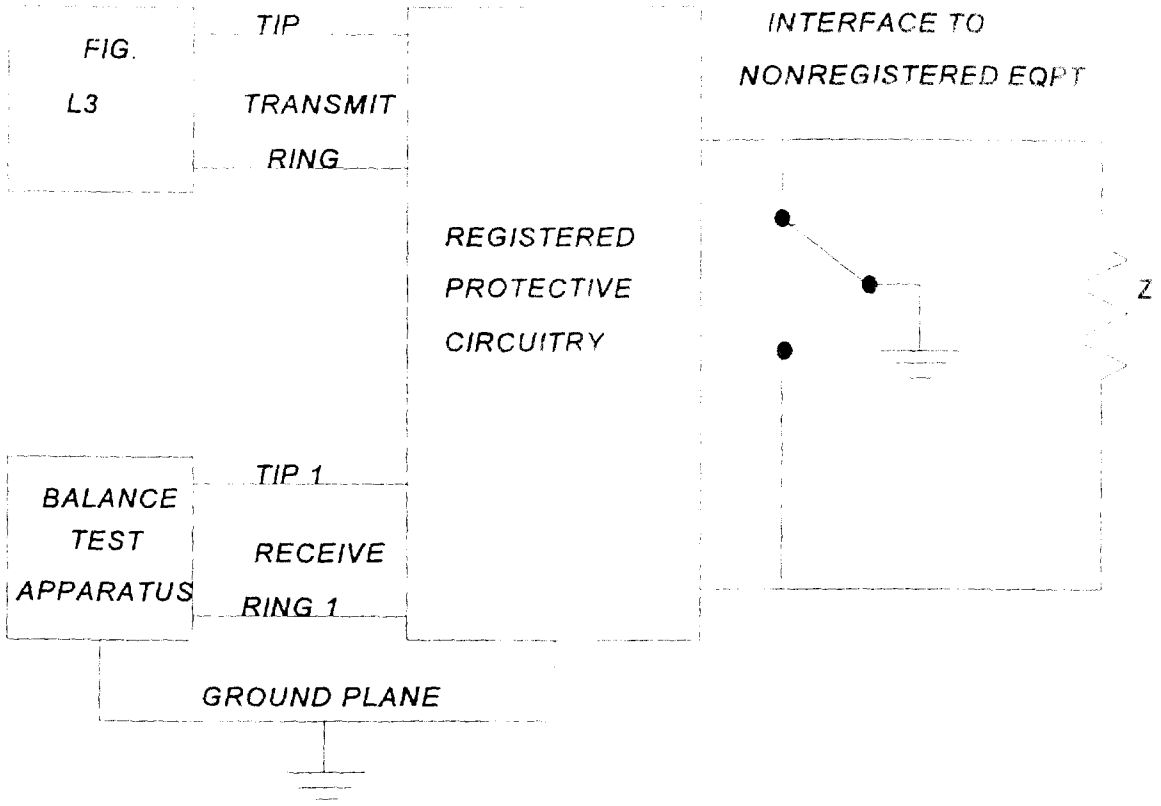


Z Selected so that the reflected impedance at tip 1 and ring 1 is 600 ohms, 135 ohms, or 100 ohms depending on service type of EUT.

Configuration shown is for measurement of receive pair.

Figure 68.310(d)
Required Termination for Connections to Non-Registered Equipment

Appendix C

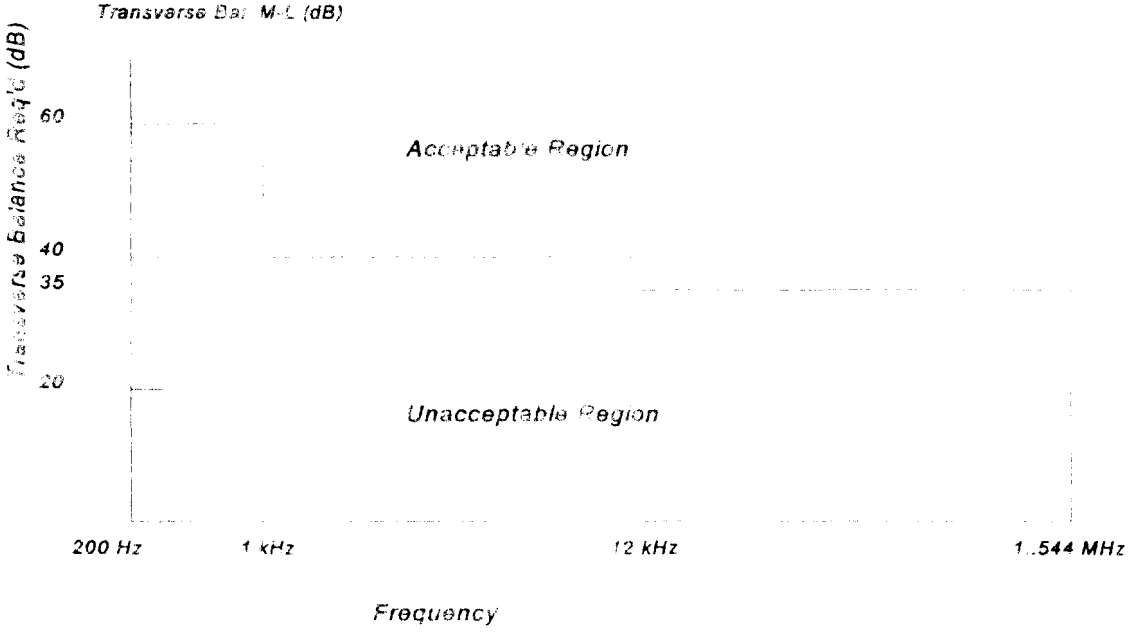


Figure 68.310(e)
Transverse Balance Requirements for Digital Services

10. Section 68.312 is revised to read as follows:

§ 68.312 On-hook impedance limitations.

(a) *General.* Requirements in this section apply to the tip and ring conductors of 2-wire interfaces. These requirements also apply to 4-wire loop-start or ground-start interfaces, in the following configuration:

(1) The tip and ring conductors are connected together and treated as one of the conductors of a tip and ring pair.

(2) The tip 1 and ring 1 conductors are connected together and treated as the other conductor of a tip and ring pair.

Throughout this section, references will be made to simulated ringing. Ringing voltages to be used and impedance limitations associated with simulated ringing are shown in Table 68.312(a).

Table 68.312(a)

Ringing Type	Range of compatible ringing frequencies (Hz)	Simulated ringing voltage superimposed on 56.5 volts dc	Impedance limitations (ohms)
A.....	20 ± 3.....	40 to 130 volts rms	1400
	30 ± 3.....	40 to 130 volts rms	1000
B.....	15.3 to 34	40 to 130 volts rms	1600
	> 34 to 49	62 to 130 volts rms	1600
	> 49 to 68	62 to 150 volts rms	1600

(b) *Limitations on individual equipment intended for operation on loop-start telephone facilities.* Registered terminal equipment and registered protective circuitry shall conform to the following limitations:

(i) *On-hook resistance, metallic and longitudinal (up to 100 Vdc).* The on-hook

dc resistance between the tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground, shall be greater than 5 megohms for all dc voltages up to and including 100 volts.

(ii) *On-hook resistance, metallic and longitudinal (100 V to 200 Vdc).* The on-hook dc resistance between tip and ring conductors of a loop start interface, and between each of the tip and ring conductors and earth ground shall be greater than 30 kOhms for all dc voltages between 100 and 200 volts.

(iii) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the total dc current shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(iv) *Ringing frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between the tip and ring conductors (defined as the quotient of applied ac voltage divided by resulting true rms current) shall be greater than or equal to the value specified in Table 68.312(a). The equipment must comply for each ringing type which is listed as part of the ringer equivalence.

(v) *Ringing Frequency Impedance (longitudinal).* During the application of simulated ringing, as listed in Table 68.312(a), to a loop start interface, the impedance between each of the tip and ring conductors and ground shall be greater than 100 kohms. The equipment must comply with each ringing type listed in the ringer equivalence.

(c) *Limitations on individual equipment intended for operation on ground start telephone facilities.* Registered terminal equipment and registered protective circuitry shall conform to the following limitations:

(1) *DC current during ringing.* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total dc current flowing between tip and ring conductors shall not exceed 3.0 milliamperes. The equipment must comply for each ringing type listed as part of the ringer equivalence.

(2) *Ringing frequency impedance (metallic).* During the application of simulated ringing, as listed in Table 68.312(a), to a ground start interface, the total impedance of the parallel combination of the ac impedance across tip and ring conductors and the ac impedance from the ring conductor to ground (with ground on the tip conductor) shall be greater than the value specified in Table 68.312(a). The equipment must comply for

each ringing type listed as part of the ringer equivalence.

(d) *Ringer Equivalence Definition.* The ringer equivalence number is defined to be the value determined in paras. (d)(1) or (d)(2) of this section, as appropriate, followed by the ringer type letter indicator representing the frequency range for which the number is valid. If Ringer Equivalence is to be stated for more than one Ringing Type, testing shall be performed at each frequency range to which Ringer Equivalence is to be determined in accordance with the above, and the largest resulting Ringer Equivalence Number so determined will be associated with each Ringing Type letter designation for which it is valid.

(1) For individual equipment intended for operation on loop-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the minimum measured ac impedance, as defined in paragraph (b)(1)(iv) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(2) For individual equipment intended for operation on ground-start telephone facilities, the ringer equivalence is five times the impedance limitation listed in Table 68.312(a), divided by the minimum measured ac impedance, defined in paragraph (c)(2) of this section, during the application of simulated ringing as listed in Table 68.312(a).

(e) *Ringer Equivalence Number labeling.* Registered terminal equipment and registered protective circuitry shall have at least one Ringer Equivalence Number shown on the registration label. Where options that will vary the Ringer Equivalence are involved, either each option that results in a Ringer Equivalence Number greater than 0.1 and its corresponding Ringer Equivalence shall be listed on the registration label, or the largest Ringer Equivalence Number that can result from such options shall be stated on the label. A trained, authorized agent of the Grantee may disconnect ringers, bridge ringers to another line, or execute options affecting Ringer Equivalence after the telephone company has been notified in accordance with § 68.106.

(f) *Maximum Ringer Equivalence.* All registered terminal equipment and registered protective circuitry that can affect the ringing frequency impedance shall be assigned a Ringer Equivalence. The sum of all such Ringer Equivalences on a given telephone line or loop shall not exceed 5. In some cases, a system that has a total Ringer Equivalence of 5 or less may not be usable on a given telephone line or loop.

(g) *OPS interfaces for PBX with DID (Ring trip requirement).* PBX ringing supplies whose output appears on the off-premises interface leads shall not trip when connected

to the following tip-to-ring impedance that terminates the off-premises station loop: A terminating impedance composed of the parallel combination of a 15 kohms resistor and an RC series circuit (resistor and capacitor) whose ac impedance is as specified in Table 68.312(b) below.

Table 68.312(b)

Ringing freq Hz	ac impedance ohms	
	Class B or C	Class A
20 ± 3	7000/N	1400
30 ± 3	5000/N	1000

N - Number of ringer equivalences, as specified by the manufacturer, which can be connected to the off-premises station loop.

(h) *Type Z Ringers.* Equipment that has on-hook impedance characteristics which do not conform to the requirements of this section may be conditionally registered, notwithstanding the requirements of this section, provided that it is labelled with a Ringing Type designation "Z". It should be noted that registration of equipment bearing the designation "Z" does not necessarily confer any right of connection to the telephone network under these rules. Any equipment registered with the type Z designation may only be used with the consent of the local telephone company, provided that the local telephone company does not discriminate in its treatment of equipment bearing the type Z designation.

(I) *Transitioning to the Off-Hook State.* Registered terminal equipment and registered protective circuitry shall not by design leave the on-hook state by operations performed on tip and ring leads for any other purpose than to request service or answer an incoming call, except that terminal equipment that the user places in the off-hook state for the purpose of manually placing telephone numbers in internal memory for subsequent automatic or repertory dialing shall be registerable. Make-busy indications shall be transmitted by the use of make-busy leads only as defined in § 68.3 and § 68.200(j).

11. Section 68.314 is revised to read as follows:

§ 68.314 Billing protection.

(a) *Call duration requirements on data equipment connected to the Public Switched Network, or to Tie Trunks, or to Private lines that access the Public Switched Network.* Registered data terminal equipment and registered protective circuitry shall comply with the following requirements when answering an incoming call, except in off-hook states in which the signals are transmitted and/or received by electroacoustic transducers only.

NOTE : Para. (a) of this section is applicable to terminal equipment and registered protective circuitry employed with digital services where such digital services are interconnected with the analog telephone network.

(1) *Registered Protective Circuitry.* Registered protective circuitry connected to associated data equipment shall assure that the following signal power limitations are met for at least the first 2 seconds after the off-hook condition is presented to the telephone network in response to an incoming call:

(i) Signals that appear at the protective circuitry/telephone network interface for delivery to the telephone network shall be limited to -55 dBm, (at any frequency in the range of 200 to 3200 Hertz), as such signals are delivered into a loop simulator circuit or a 600 ohm termination, as appropriate: and

(ii) Signals that appear at the protective circuitry-associated data equipment interface for delivery to associated data equipment shall be limited as follows: for any received signal power (appearing at the protective circuitry-telephone network interface) up to 0 dB with respect to one milliwatt (at any frequency in the range of 200 to 3200 Hertz), the power of signals delivered to associated data equipment shall be no greater than the signal power that would be delivered as a result of received signal power of -55 dBm

(2) *Registered Terminal Equipment.* Registered terminal equipment for data applications shall assure that, when an incoming telephone call is answered, the answering terminal equipment prevents both transmission and reception of data for at least the first two seconds after the answering terminal equipment transfers to the off-hook condition. For the purpose of this requirement, a fixed sequence of signals that is transmitted (and originated within) and/or received by the registered terminal equipment each time it answers an incoming call shall not be considered data, provided that such signals are for one or more of the following purposes:

(i) Disabling echo control devices,

(ii) Adjusting automatic equalizers and gain controls,

(iii) Establishing synchronization, or

(iv) Signaling the presence and if required, the mode of operation, of the data terminal at the remote end of a connection

(b) *Voice and data equipment on-hook signal requirements for equipment connected to the Public Switched Network, or to Tie Trunks, or to Private Lines that Access the Public Switched Network.* Registered protective circuitry and registered terminal equipment shall comply with the following:

(1) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator or into a 600 ohm termination (where appropriate) in the on-hook state, by loop-start or ground-start equipment shall not exceed - 55 dBm within the voiceband. Registered protective circuitry shall also assure that for any input level up to 10 dB above the overload point, the power to a 2-wire loop simulator circuit or the transmit and receive pairs of a 4-wire loop simulator circuit or into a 600 Ohm termination (where appropriate) does not exceed the above limits.

(2) The power delivered into a 2-wire loop simulator circuit or into the transmit and receive pairs of a 4-wire loop simulator circuit, in the on-hook state, by reverse battery equipment shall not exceed -55 dBm unless the equipment is arranged to inhibit incoming signals.

(c) *Voice and data equipment loop current requirements for equipment connected to the Public Switched network.* The loop current through registered terminal equipment or registered protective circuitry, when connected to a 2-wire or 4-wire loop simulator circuit with the 600 ohm resistor and 500 microfarad capacitor of the 2-wire loop simulator circuit or both pairs of the 4-wire loop simulator circuit disconnected shall, for at least 5 seconds after the equipment goes to the off-hook state that would occur when answering an incoming call:

(1) Be at least as great as the current obtained in the same loop simulator circuit with minimum battery voltage and a maximum loop resistance when a 200 ohm resistance is connected across the tip and ring of the 2-wire loop simulator circuit or connected across the tip/ring and tip 1/ring1 conductors (tip and ring connected together and tip 1 and ring 1 connected together) of the 4-wire loop simulator circuit in place of the registered terminal equipment or registered protective circuitry; or

(2) Not decreased by more than 25 percent from its maximum value attained

during this 5-second interval; unless the equipment is returned to the on-hook state during the above 5 second interval.

(3) The above requirements also apply in the hold state and any off-hook state.

(d) *Signaling interference requirements.*

(1) The signal power delivered to the network interface by the registered terminal equipment and from signal sources internal to registered protective circuitry in the 2450 Hz to 2750 Hz band shall be less than or equal to the power present simultaneously in the 800 Hz to 2450 Hz band for the first 2 seconds after going to the off-hook state.

(2) Registered terminal equipment for connection to subrate or 1.544 Mbps digital services shall not deliver digital signals to the telephone network with encoded analog content energy in the 2450 to 2750 Hertz band unless at least an equal amount of encoded analog energy is present in the 800 to 2450 Hertz band for the first two seconds after going to the off-hook state.

(e) *On-Hook Requirements for registered terminal equipment for connection to subrate and 1.544 Mbps digital services.* Registered terminal equipment and registered protective circuitry shall comply with the following:

(1) The power delivered to the telephone network in the on-hook state as derived by a zero level decoder shall not exceed -55 dBm equivalent power for digital signals within the voiceband.

(2) Registered protective circuitry shall also assure that the power to a zero level decoder does not exceed the above limits for any input level up to 10 dB above the overload point.

(3) Reverse battery interface. The power derived by a zero level decoder, in the on-hook state, by reverse battery equipment, shall not exceed -55 dBm, unless the equipment is arranged to inhibit incoming signals.

(f) *Off Hook Requirements.* Off-hook signal requirements for registered terminal equipment connecting to 1.544 Mbps digital services. Upon entering the normal off-hook state, in response to alerting, for subrate channels, registered terminal equipment shall continue to transmit the signaling bit sequence representing the off-hook state for 5 seconds, unless the equipment is returned to the on-hook state during the above 5-second interval.

(g) *Operating Requirements for Direct Inward Dialing.*

(1) For registered terminal equipment, the off-hook state shall be applied within 0.5 seconds of the time that:

(i) The terminal equipment permits the acceptance of further digits that may be used to route the incoming call to another destination.

(ii) The terminal equipment transmits signals towards the calling party, except for the call progress tones, i.e., busy, reorder and audible ring, and the call is:

(A) Answered by the called, or another station;

(B) Answered by the attendant;

(C) Routed to a customer controlled or defined recorded announcement, except for "number invalid," "not in service" or "not assigned;"

(D) Routed to a dial prompt; or

(E) Routed back to the public switched telephone network or other destination and the call is answered. If the status of the answered call cannot be reliably determined by the terminal equipment through means such as, detection of answer supervision or voice energy, removal of audible ring, etc., the off-hook state shall be applied after an interval of not more than 20 seconds from the time of such routing.

The off-hook state shall be maintained for the duration of the call.

(2) For registered protective circuitry:

(i) Registered protective circuitry shall block transmission incoming from the network until an off-hook signal is received from the terminal equipment.

(ii) Registered protective circuitry shall provide an off-hook signal within 0.5 s following the receipt of an off-hook signal from the terminal equipment and shall maintain this off-hook signal for the duration of the call.

12. Section 68.316 is amended by revising the section heading to read as follows:

§ 68.316 Hearing aid compatibility: technical requirements.

13. Section 68.317 is amended by revising the section heading to read as follows:

§ 68.317 Hearing aid compatibility volume control: technical standards

14. Section 68.318 is amended to read as follows:

§ 68.318 Additional limitations.

(a) *General.* Registered terminal equipment for connection to those services discussed below must incorporate the specified features.

(b) *Registered terminal equipment with automatic dialing capability.*

(1) Automatic dialing to any individual number is limited to two successive attempts. Automatic dialing equipment which employ means for detecting both busy and reorder signals shall be permitted an additional 13 attempts if a busy or reorder signal is encountered on each attempt. The dialer shall be unable to re-attempt a call to the same number for at least 60 minutes following either the second or fifteenth successive attempt, whichever applies, unless the dialer is reactivated by either manual or external means. This rule does not apply to manually activated dialers that dial a number once following each activation

NOTE: Emergency alarm dialers and dialers under external computer control are exempt from these requirements.

(2) If means are employed for detecting both busy and reorder signals, the automatic dialing equipment shall return to its on-hook state within 15 seconds after detection of a busy or reorder signal.

(3) If the called party does not answer, the automatic dialer shall return to the on-hook state within 60 seconds of completion of dialing.

(4) If the called party answers, and the calling equipment does not detect a compatible terminal equipment at the called end, then the automatic dialing equipment shall be limited to one additional call which is answered. The automatic dialing equipment shall comply with paras. (1), (2), and (3) of this section for additional call

attempts that are not answered.

(5) Sequential dialers shall dial only once to any individual number before proceeding to dial another number.

(6) Network addressing signals shall be transmitted no earlier than:

(i) 70 ms after receipt of dial tone at the network demarcation point;

OR

(ii) 600 ms after automatically going off-hook (for single line equipment that does not use dial tone detectors);

OR

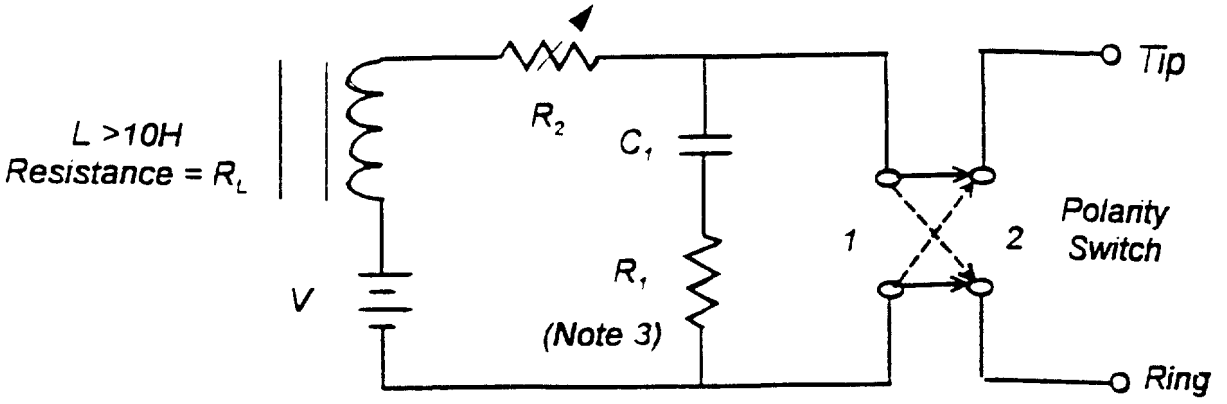
(iii) 70 ms after receipt of CO ground start at the network demarcation point.

(c) *Line seizure by automatic telephone dialing systems.* Automatic telephone dialing systems which deliver a recorded message to the called party must release the called party's telephone line within 5 seconds of the time notification is transmitted to the system that the called party has hung up, to allow the called party's line to be used to make or receive other calls.

(d) *Telephone Facsimile Machines; Identification of the sender of the message.* It shall be unlawful for any person within the United States to use a computer or other electronic device to send any message via a telephone facsimile machine unless such message clearly contains, in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual. Telephone facsimile machines manufactured on and after December 20, 1992 must clearly mark such identifying information on each transmitted message.

(e) *Requirement that registered equipment allow access to common carriers .* Any equipment or software manufactured or imported on or after April 17, 1992, and installed by any aggregator shall be technologically capable of providing consumers with access to interstate providers of operator services through the use of equal access codes. The terms used in this paragraph shall have meanings defined in § 64.708 of this chapter (47 CFR 64.708).

LOOP SIMULATOR FOR LOOP START AND GROUND START CIRCUITS



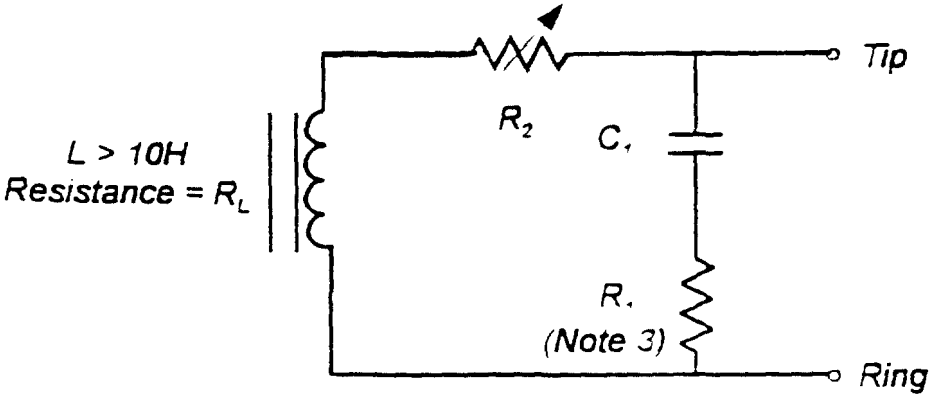
C_1 = 500 mfd -10% + 50% R_1 = 600 ohms ± 1%

Condition	V - Volts	Switch Position for Test	R2 + RL
1	Min 42.5 Max 56.5	Both	Continuously variable over 400 to 1740 ohms
2	105	2	2000 ohms

1. Means shall be used to generate, at the point of tip and ring connections to the terminal equipment or protective circuitry, the paramenters of dc line current and ac impedance which are generated by the illustrative circuit depicted above (as appropriate for the equipment under test).
2. In the Transverse Balance Limitations, Section 68.310, the use of the "dc portion of the loop simulator circuit" is specified. In such case components of R_1 and C_1 should be removed.
3. Tests for compliance may be made with either R_1 = 600 ohms or R_1 replaced by the alternative configuration shown in Figure 68.3(g).

Figure 68.3(a)

Loop Simulator for Reverse Battery Circuits



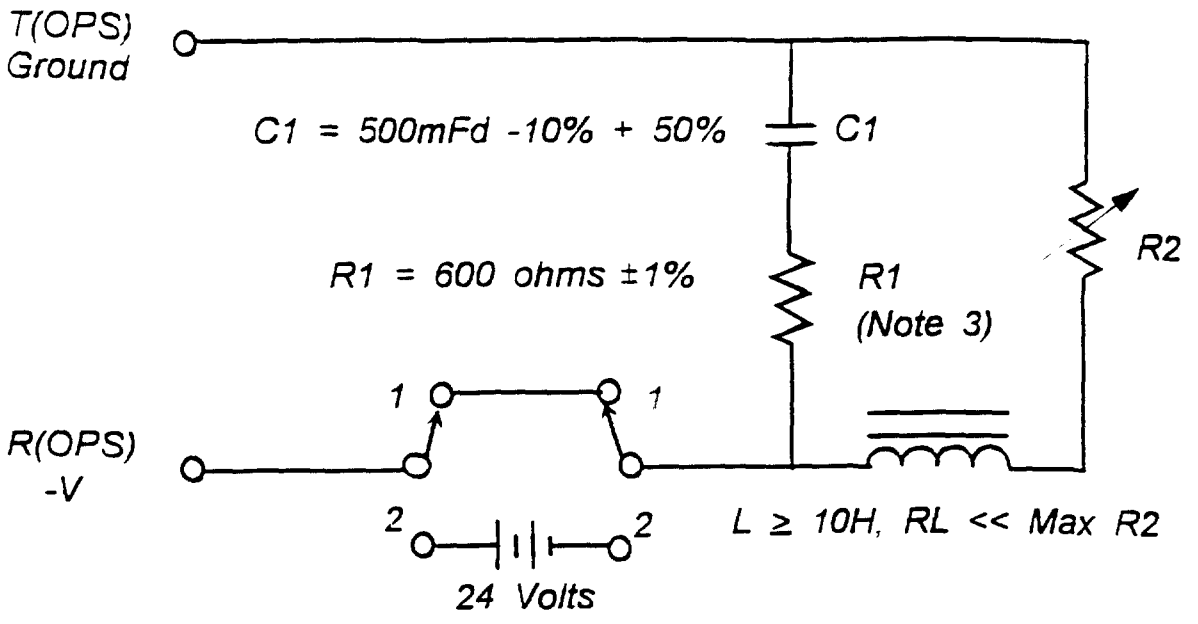
C_1 = 500 mFd -10% + 50%

R_1 = 600 ohms ± 1%

Notes for Figure 68.3(a) apply also to this drawing

$R_2 + R_L$
Continuously variable over 400 to 2450 ohms

Figure 68.3(b)



		R2 + RL Continuously Variable Over the Following Range		
Condition	Switch Position for Test	Class A RL	Class B RL	Class C RL
1	1	to 200 ohms	to 800 ohms	to 1800 ohms
2	2	N.A.	200 to 2300 ohms	900 to 3300 ohms

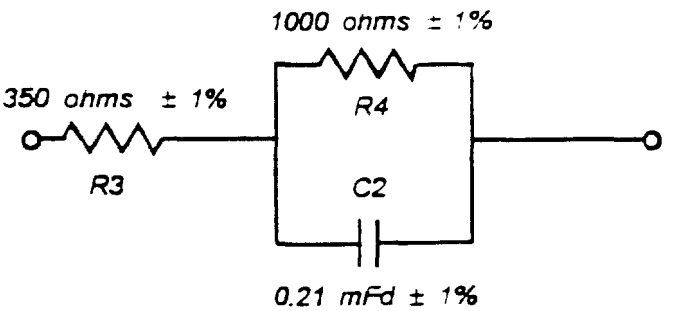
The minimum current for all resistance ranges shall be 16 mA.

Notes: (1) Means shall be used to generate, at the point of tip (T OPS) and ring (R OPS) connections to the PBX.the range of resistance and impedance which are employed by the illustrative circuit depicted above.
(2) In the transverse balance limitations, Section 68.310, the use of the "dc portion of the line simulator" is specified. In such case, components R1 and C1 above shall be removed.
(3) Tests for compliance may be made with either R1 = 600 ohms or R1 replaced by the alternative termination specified in Figure 68.3(g).

OFF PREMISES LOOP SIMULATOR

Figure 68.3(f)

ALTERNATIVE TERMINATION

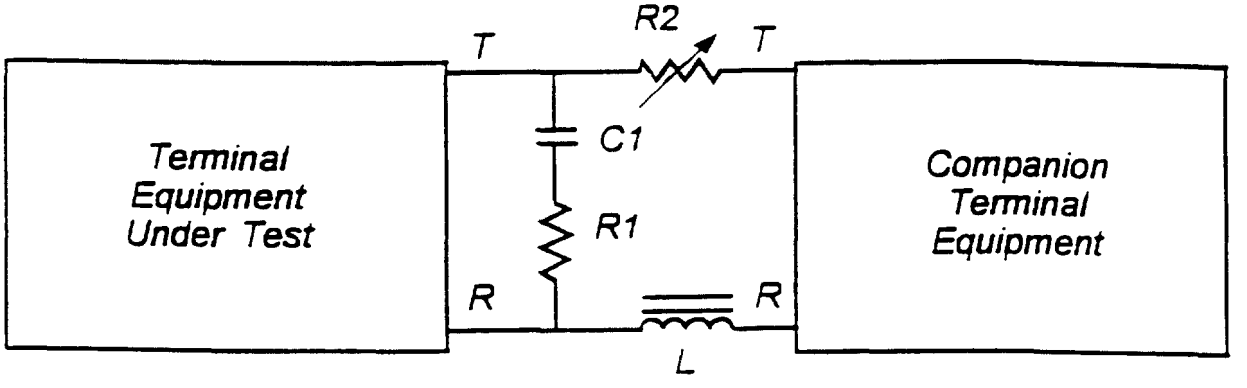


Note: When this alternative termination is used during signal power compliance testing, it replaces R1 (600 ohms) in the loop simulator circuit.

Figure 68.3(g)

LOOP SIMULATOR CIRCUIT

VOICEBAND METALLIC CHANNELS



C1 = 500mFd -10%, +5%

R1 = 600 ohms ±1%

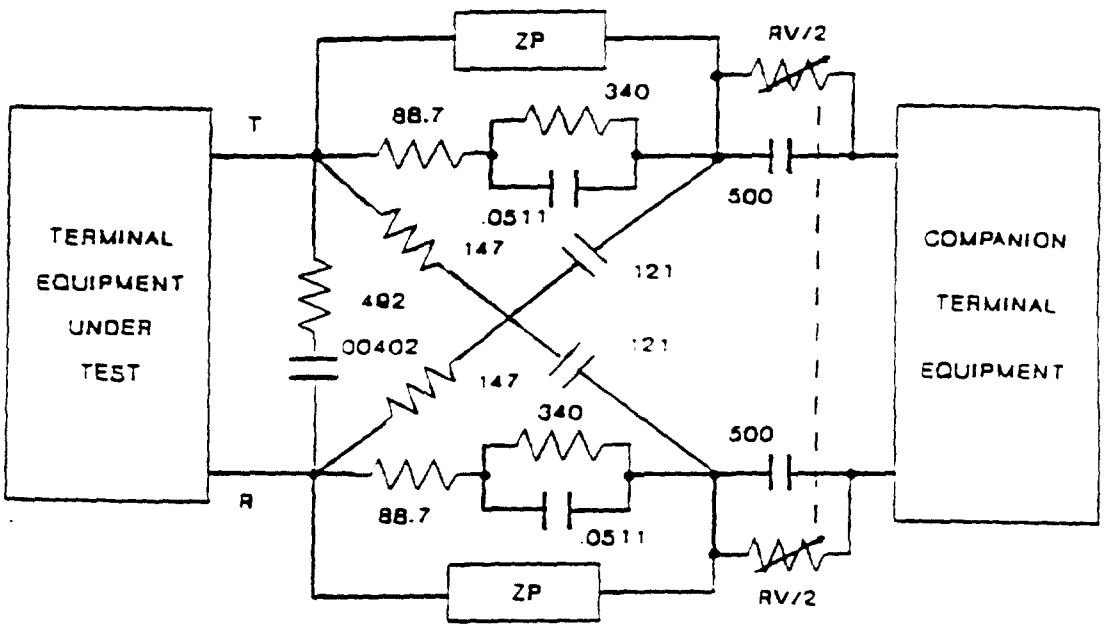
L = 10H, Resistance = RL

R2 + RL are continuously variable from RL to RX;

Where RX = Signaling range of Equipment Under Test, and RL << RX

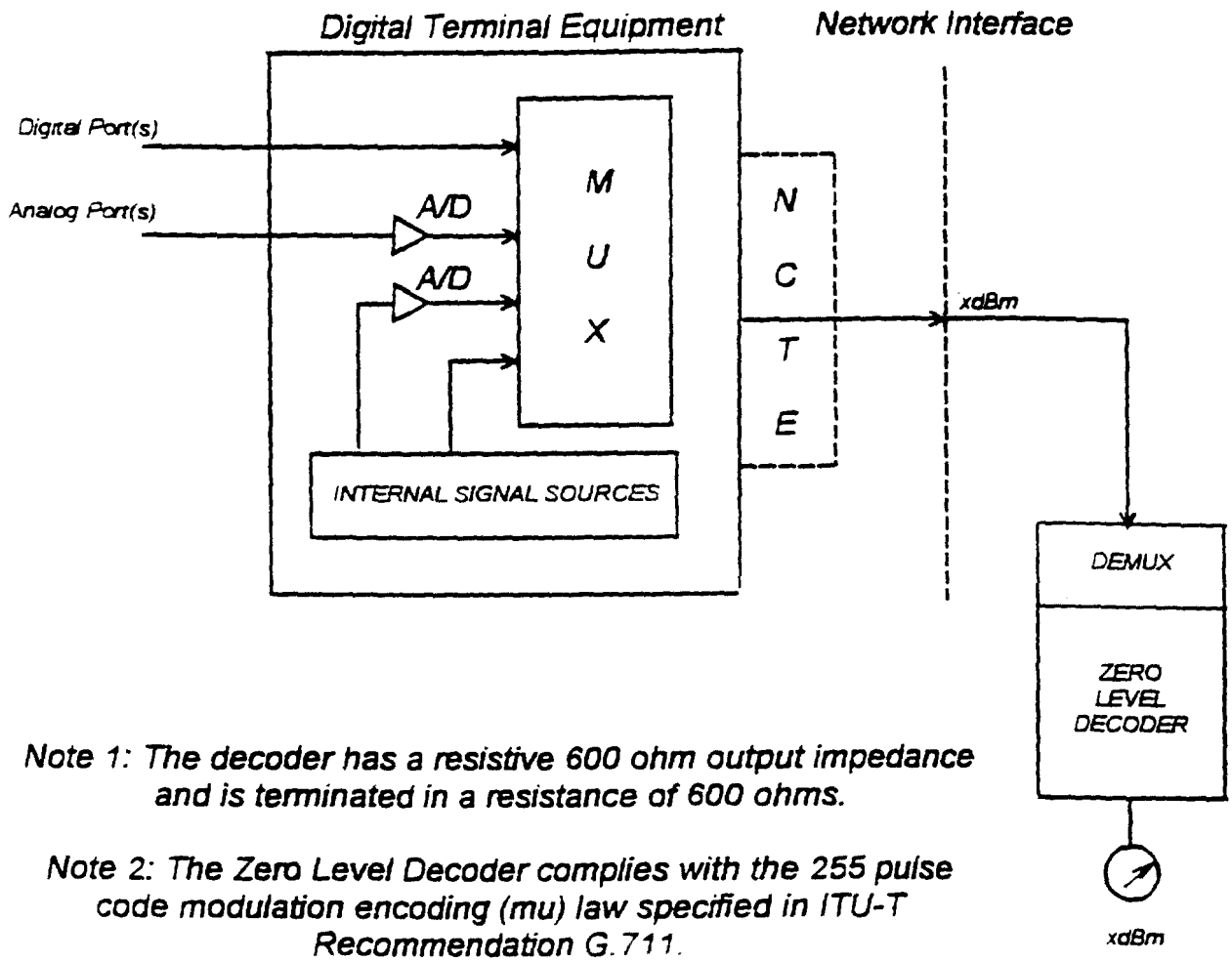
Notes: For Transverse Balance Measurements, Section 68.310, the DC portion of the loop simulator should be provided by removing R1 and C1. Companion Terminal Equipment grounds (including power supplies) must be isolated from Transverse Balance circuit grounds.

Figure 68.3(h)



Resistances (Ohms), Capacitances (uF), Tolerances = 2%.
RV = RP = 50 thru 3000 Ohms.
ZP is the magnitude of the lowpass filter impedance which is (25 Ohm dc;) 3 Kohm from 10 Hz to 6 Khz.
RP/2 = dc resistance of lowpass filter, ZP in parallel with 428.7 Ohm.

Figure 68.3(i) LADC Impedance Simulator for Metallic Voltage Tests

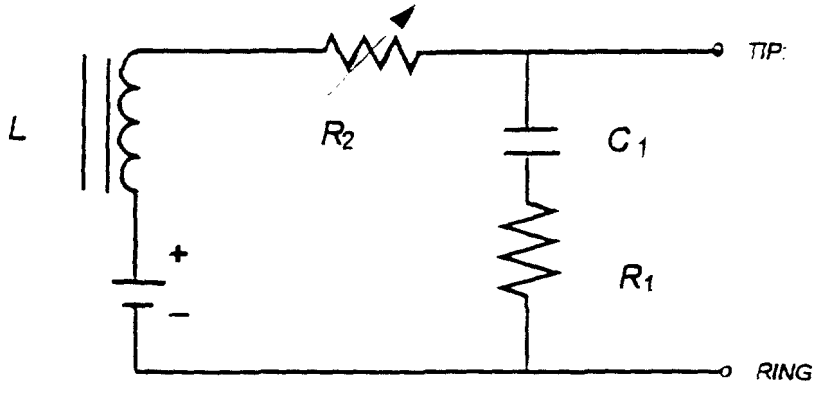


Note 1: The decoder has a resistive 600 ohm output impedance and is terminated in a resistance of 600 ohms.

Note 2: The Zero Level Decoder complies with the 255 pulse code modulation encoding (mu) law specified in ITU-T Recommendation G.711.

ZERO-LEVEL DECODER TEST CONFIGURATION FOR SUBRATE AND 1.544 MBPS DIGITAL CHANNELS

Figure 68.3 (j)



$L \geq 10H$ (Resistance = R_L)

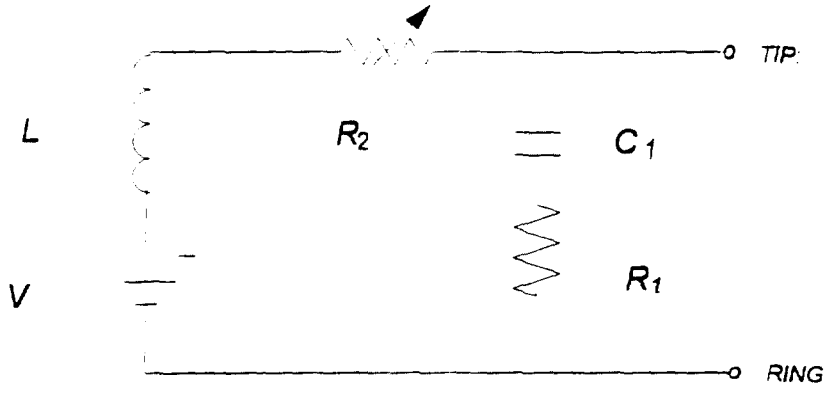
$R_1 = 600$ ohms $\pm 1\%$

$C_1 = 500mF$, -10%, +50%

TEST CONDITIONS FOR ANALOG MODE

V (volts)		R2 + RL (ohms)
Min	Max	continuously variable
36	46	610 to 1510

SIMULATOR CIRCUIT FOR PSDS IN ANALOG MODE
Fig 68.3(k)



L = or > 10H (Resistance = R_L)

R_1 = 600 ohms +/- 1%

C_1 = 500mF, -10%, +50%

TEST CONDITIONS FOR ANALOG MODE

V (volts)		R2 + RL (ohms)
Min	Max	continuously variable
36	46	610 to 1510

SIMULATOR CIRCUIT FOR PSDS IN ANALOG MODE
Fig 68.3(m)